LARGE APERTURE MEDIUM TELEPHOTO LENS SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to medium telephoto lens systems and, more particularly, to a medium telephoto lens system having a large aperture ratio (hereinafter referred to as "A large aperture medium telephoto lens system").

2. Description of the Related Art

As medium telephoto lenses, Gauss type lenses and modified Gauss type lenses have heretofore been widely used because these lenses have excellent image-forming performance despite a simple lens arrangement composed of 6 to 8 lens elements.

Further, in recent years, so called "floating technique" has been introduced into medium telephoto lens systems of the type described above. Consequently, it has become possible to obtain excellent performance for objects in the object distance range of from the infinite object point to the nearest object point as far as flat image-forming performance is concerned.

Meanwhile, autofocus single-lens reflex cameras have recently spread remarkably. As a result, interchangeable lenses have also been demanded to reduce the weight of a lens unit movable during focusing and to shorten the distance through which the lens unit moves to effect focusing.

However, the focusing method used with the conventional Gauss type lens is to move the entire lens system to effect focusing or to vary a specific lens spacing while moving the entire lens system. In either case, the entire lens system, which is heavy, must be moved through a relatively long distance. Therefore, the conventional Gauss type lens is not suitable for use in an autofocus camera from the viewpoint of focusing speed and power consumption.

To solve the problem, the present applicant has proposed lens systems which are disclosed, for example, in Japanese Patent Application Laid Open No. 03-200909 and U.S. Pat. No. 4,812,027.

The lens systems disclosed in the above-mentioned publications are of the rear focusing type, which is composed of a front lens unit having three lens elements, i.e., a positive lens element, a positive lens element, and a negative lens element, based on the front lens group of the Gauss type lens, and a rear lens unit including a plurality of lens elements and having a positive refractive power as a whole. In the rear focusing type, focusing is effected by moving only the rear lens unit.

However, the rear focusing system suffers from the disadvantage that the closest distance performance (i.e., the image-forming performance for an object at the closest focusing distance) generally degrades in the case of "fast" lenses having an f-number smaller than 1.7, although it can make excellent aberration correction for relatively "slow" lenses having an f-number larger than 1.7.

The rear focusing system further involves the problem that the balance between spherical aberration and field curvature deteriorates at a specific object distance.

In view of the above-described problems, an object of the present invention is to provide a large aperture medium telephoto lens system which is capable of focusing by movement of a lens unit having a minimal number of lens elements and yet excellent in the closest distance performance.

SUMMARY OF THE INVENTION

To attain the above-described object, the present invention provides a lens system including, in order from the object side, a 1-st lens unit having a positive refractive power, a 2-nd lens unit having a positive refractive power, and a 3-rd lens unit having a positive refractive power. During focusing, both the 1-st and 3-rd lens units are fixed, whereas the 2-nd lens unit is movable along an optical axis. The lens system satisfies the following conditions (1) to (3):

$$1.8<F1/f<2.4 \quad (1)$$

$$0.8<F2/f<0.96 \quad (2)$$

$$9<F3/f<20 \quad (3)$$

where

F1: the focal length of the 1-st lens unit;

F2: the focal length of the 2-nd lens unit;

F3: the focal length of the 3-rd lens unit; and

f: the focal length of the entire lens system.

A lens system having excellent closest distance performance can also be obtained when any one of the above conditions (1) to (3), or two of them, that is, (1) and (3), or (2) and (3), are satisfied.

In addition, the present invention provides a lens system including, in order from the object side, a 1-st lens unit having a positive refractive power, a 2-nd lens unit having a positive refractive power, and a 3-rd lens unit having a positive refractive power. The 1-st lens unit includes, in order from the object side, a positive lens element having a convex surface directed toward the object side, a positive meniscus lens element having a convex surface directed toward the object side, and a negative meniscus lens element having a convex surface directed toward the object side. The 2-nd lens unit includes two sub units, that is, a front sub unit and a rear sub unit, in order from the object side. The front sub unit includes, in order from the object side, a positive lens element having a convex surface directed toward the object side, and a negative lens element whose image-side surface is more steeply concaved than the object-side surface thereof. The rear sub unit includes, in order from the object side, a cemented lens component and a positive lens element. The cemented lens component is composed of a negative lens element having a concave surface directed toward the object side, and a positive lens element having a convex surface directed toward the image side. The 2-nd lens unit further includes an aperture stop disposed between the front and rear sub units. The 3-rd lens unit has a positive lens element. The lens system satisfies the following conditions (4) to (6):

$$0.28<D1/f<0.36 \quad (4)$$

$$0.19<S1/f<0.23 \quad (5)$$

$$0.62<r1/f<1.0 \quad (6)$$

where

D1: the axial thickness of the 1-st lens unit;

S1: the axial air spacing between the 1-st and 2-nd lens units when the lens system is focused at the infinite object point; and

r1: the radius of curvature of the object-side surface of the positive lens element closest to the object side in the 1-st lens unit.

In the present invention, the following condition (7), (15) or (17) may be satisfied instead of the condition (6).